An Investigation of Thickened Hot Chocolate Recipes: Trialing Multiple Factors to Determine a Mildly Thick Consistency Mixture within the IDDSI Framework

An Honors Thesis (HONR 499)

by

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Abstract

Consistent treatment is essential for providing high quality care to dysphagia patients. However, variations in thickened liquids across facilities and clinicians prevents this consistency. Recently, standardization initiatives have been put into effect but practicing clinicians struggle with obtaining the time and resources needed to adequately test thickened recipes. Identifying recipes that can be used universally to achieve a target liquid consistency helps to improve the quality of treatment. In this investigation factors such as thickener, beverage brand, ingredients, and temperature were considered to determine a hot chocolate recipe that reached an optimal nectar consistency. Data was collected on various hot chocolate recipes using viscometers and the IDDSI flow test, and comparisons were made between the recipe results, viscosity ranges, and Varibar Barium. I evaluated these outcomes to determine how the results could influence hot chocolate recipes in clinical practice.

Acknowledgements

I would like to thank Mrs. Mary Ewing for agreeing to be my thesis advisor and helping me to navigate through this journey. It was with her advice and guidance that I was able to succeed in this project. I would also like to thank Dr. Ranjith Wijesinghe for all of his kindness and support. Lastly, I would like to thank my friends and family. In a semester full of extraordinary challenges, they continuously supported and encouraged me on this project.

Process Analysis

The foundation for my research on this project began during the Spring semester of 2019 when I took the Immersive Learning Course *Analysis of Fluid Viscosities Used to Treat Human Dysphagia*. Through the duration of my time in that course, I gained a strong base of knowledge regarding dysphagia and swallowing treatment. Furthermore, I had the opportunity to work in a group that tested viscosities of beverages popular in adult populations. The accumulation of these experiences from the course remained with me as I considered the effects on a population near to my heart, the geriatric population. I have worked in the dietary department at various assisted living facilities for six years, and the summer after my Immersive Learning experience I happened to worked in the memory care unit of one of those facilities. It was a perfect opportunity for me to combine the knowledge from that course into observations on a real-life environment that worked with geriatric dysphagia patients. I noticed that there were three different methods for achieving the thickened liquids that were served to the residents. The first was commercially purchased liquids that came pre-thickened to either a nectar (mildly thick) or honey (moderately thick) consistency. For this facility that included apple juice, cranberry juice, orange juice, and milk. The second method only applied to coffee and used a commercially purchased powder packet that contained coffee and thickening properties. This packet of powder was poured into a mug and mixed with hot water to achieve a thickened coffee. The third method was following the directions on the thickener package to mix the beverage to a certain thickness, and this was used for any liquids not covered under the first two methods. I witnessed chocolate milk, fruit punch, lemonade, Hi-C, and tea being mixed this way. Beverages being made using the third method were less common and when they were made it was done by people with a variety of backgrounds, ranging from dietary to medical staff. However, these beverages were

also typically favorites of the residents. It made me think about how strange it was that I never encountered thickened hot chocolate because in my experience hot chocolate is an incredibly popular beverage among residents year round. This was the catalyst for my thesis. I decided to investigate factors such as thickener, temperature, and type of hot chocolate to see what combination would create the most reliable mixture for a nectar (mildly thick) consistency diet. The goal was to use the data to see if a specific recipe could be pinpointed and recommended for producing the ideal thickened hot chocolate. This would help to maintain consistency in treatment no matter who thickened the liquid and also hopefully make the process of thickening hot chocolate an efficient option.

The types of hot chocolate that I selected for this project were based off of what I saw being used in the assisted living facilities. In my experience Swiss Miss and Nestle were equally popular among the facilities and there was also always sugar free counterparts, so I chose to investigate those four. I decided to mix each hot chocolate with two different thickeners so that I could compare their performance. A challenge that I encountered was trying to balance the desire to test each factor in depth but also being conscientious of what could realistically be accomplished in the time frame I was working with. I specifically felt this struggle a lot when deciding how to approach testing the temperature and adding thickener to the recipe. The way that I ended up deciding how to proceed with those trials was by analyzing how the hot chocolates performed with thickening in the original recipes. Realizing that there were not significant differences in the regular versus the sugar free data, I decided to proceed using only the regular hot chocolates for investigating the other factors.

Once I had collected the data from my trials, I entered the details of the test in a spreadsheet document for each recipe. (Appendices item 1) I used those spreadsheets to compile my

comparison graphs on the trial results. Analyzing the data through a new lens, I encountered another challenge with my project which was realizing that the conclusions that I was drawing did not indicate the concrete recipe I was hoping to achieve. Recognizing that I would not reach my desired outcome was disappointing, but during this time I recognized the results from my research could still have a positive impact even if there are still unanswered questions. At the end of the day the most important goal is always that patients are receiving consistent, high quality care and steps toward this are always valuable.

Written Thesis

Introduction:

There are numerous causes that can result in dysphagia, the term for swallowing difficulties. Strokes and dementia are two of those causes that are common in the elderly population and the effects can pose a major threat to the nutritional intake and hydration of these patients. (Carnaby, Crary, Madhavan, Sura, 2012) The American Speech-Language-Hearing Association (ASHA) describes one role of the speech-language pathologist (SLPs) in these cases is to provide treatment that is effective and safe. One type of treatment that can be implemented is dietary texture modification which is when food and liquids are altered so that the consistency is more conducive for safe swallowing. (Clave, Newman, Speyer, Vilardell, 2016) However, there is a lack of consistency in the viscosity, or thickness, of the thickened liquids produced among clinicians and facilities. These unintentional variations in liquid consistency is problematic for safe liquid intake and consequently the quality of patient care. To combat this issue, standardization guidelines have been developed to help minimalize the acceptable thickness ranges. The National Dysphagia Diet (NDD) outlines four levels of liquid viscosity: thin (1-50cP), nectar-like (51-350cP), honey-like (351-1,750cP), and spoon-thick (>1,750cP). (McCullough, Pelletier, Steele, 2003) A more recently introduced take on standardization is the International Dysphagia Diet Standardisation Initiative (IDDSI) Framework. In this continuum there are five liquid levels: Level 0 Thin, Level 1 Slightly Thick, Level 2 Mildly Thick, Level 3 Moderately Thick, and Level 4 Extremely Thick. While implementing standardizations and common terminology can help to increase consistency, practicing SLP's lack the excess time and

resources necessary to adequately test recipes. (Cichero, Chen, Dantas, Duivestein, 2017) This investigation aimed to help mitigate these testing demands by trialing recipes with a beverage that could be useful to the aging population, hot chocolate. Factors such as type of hot chocolate, thickener, and temperature were considered with a focus on creating a nectar thick consistency. The temperature element was included to test the levels of "likeability" that could be safely produced. Mills (2008) describes likeability of a thickened liquid to be the accumulation of variables that make a patient more or less inclined to consume the liquid. For hot chocolate temperature is undoubtedly an important aspect of this. Although temperature does not tend to affect the thickness of nectar consistency liquids over time, it is important to test for potential variability in the initial thickening of high temperature liquids. (Pierce, Koperna, Scarnecchia, 2004; Chambers, Garcia, Matta, 2008) The nectar (mildly thick) consistency of the recipes was measured in its viscosity, expressed in centipoise (cP), and compared to the NDD nectar-like range, IDDSI level 2, and Varibar Barium. Varibar Barium was included because it is a product commonly used in instrumental evaluations that assess swallowing performance and these swallowing evaluations are critical in determining what liquid viscosities can safely be prescribed to an individual. (Fink, Ross, 2009; Brodsky, Fynes, Smith, 2019) Using these parameters, various recipes were tested to determine if any were more ideal for clinical application.

Methods:

Four different hot chocolates were tested in these trials. The hot chocolates that were used include Nestle Classic Rich Milk Chocolate (Nestle regular), Nestle No Sugar Added Rich Chocolate (Nestle sugar free), Swiss Miss Milk Chocolate (Swiss Miss regular), and Swiss Miss Milk Chocolate No Sugar Added (Swiss Miss sugar free). In each trial, two eight ounce batches

were prepared separately in order to follow the directions for making the hot chocolate. Each batch began with pouring one hot chocolate packet into a beaker. In a separate beaker, eight ounces of lukewarm water was measured out and heated in the microwave for one minute and thirty seconds. The heated water was then poured into the beaker with the hot chocolate powder and stirred for ten seconds using a fork. Then Simply Thick or Thik & Clear was mixed according to the specific nectar consistency instructions on the product. When mixing with Simply Thick, two individual serving packets were squeezed into the hot chocolate and stirred briskly for twenty seconds. When mixing with Thik & Clear, the hot chocolate was slowly stirred with the fork while slowly tapping four teaspoons of the thickener in. Once the four teaspoons were mixed in, the liquid was stirred briskly for twenty seconds and left to stand for five minutes. After thickening, the International Dysphagia Diet Standardization Initiative (IDDSI) flow test was performed on both batches and the two were combined into a sixteen-ounce beaker and gently stirred together. The thickened liquids were then tested using a Brookfield DV2T Viscometer for twenty-three minutes and the data was recorded on spreadsheets.

All of the hot chocolates were tested following this process, but there were additional trials that contained variations. The first variation was in the time the water was heated in the microwave. There was one trial where the water was heated for one minute and one trial where the water was heated for two minutes, but everything else in the process remained the same. The second variation was in the amount of thickener added to the hot chocolate. There were trials where the amount of thickener used was increased by ½ (one additional packet for Simply Thick, two additional teaspoons for Thik & Clear) and trials where the amount of thickener used was increased by ¼ (one additional teaspoon for Thik & Clear), but everything else in the process

remained the same. Simply Thick did not have any trials that increased the thickener amount by ¼ due to the impracticality of dividing thickener packets into exact halves.

Results:

Figures one through five show the data of each hot chocolate when it was mixed with either thickener following the nectar consistency instructions, figures six and seven are the results of water being heated for varying amounts of time, and figures eight through ten show the data of the hot chocolate recipes when the amount of thickener is increased. The graphs represent the viscosity of each recipe where the target was to reach a nectar consistency. In these graphs the shaded box outlines the NDD nectar consistency range and the black line is a reference for the viscosity of Varibar Nectar Thick Barium. The table charts represent the results from the IDDSI ten second flow test and the corresponding IDDSI level of each recipe. The target for the IDDSI test was for the liquid to be an IDDSI level 2 (mildly thick).

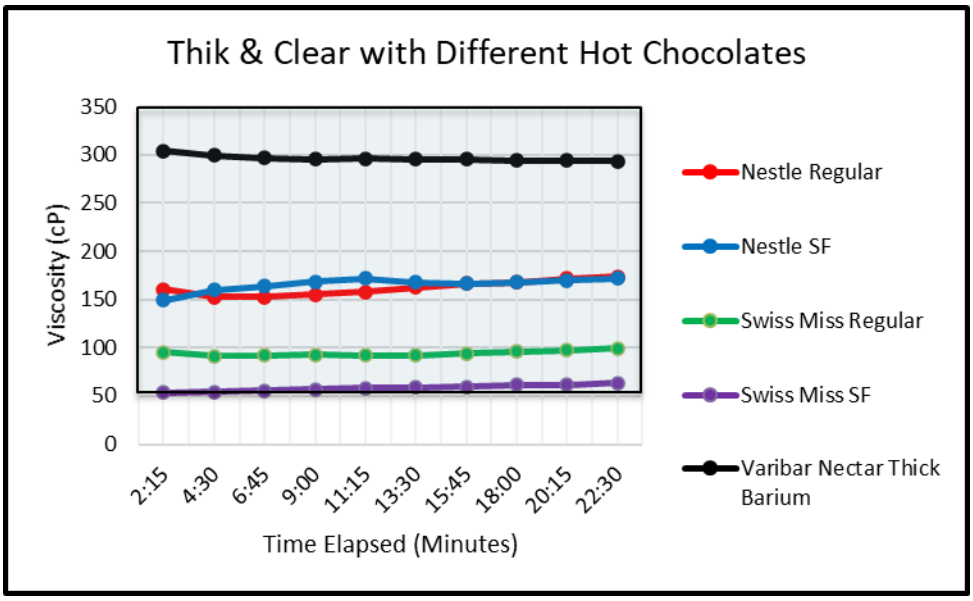

Figure 1. Thik & Clear with Different Hot Chocolates

All of the hot chocolate recipes following the Thik & Clear nectar consistency directions fell within the appropriate NDD range (51cP-350cP). The Nestle regular (152.8cP-173.8cP) and

Nestle sugar free (149.6cP-172.2cP) maintained a close viscosity range to one another. However, the Swiss Miss regular (91.4cP-99.6cP) had a higher viscosity than Swiss Miss sugar free (53.8cP-63.4cP), and both Swiss Miss recipes were lower in viscosity than the Nestle recipes. Additionally, even though the Swiss Miss sugar free recipe was within the nectar thick range, the lowest viscosity was only 2.8cP above the minimum. None of the recipes with Thik & Clear were consistent with the Varibar Nectar Thick Barium (293.6cP-304cP).

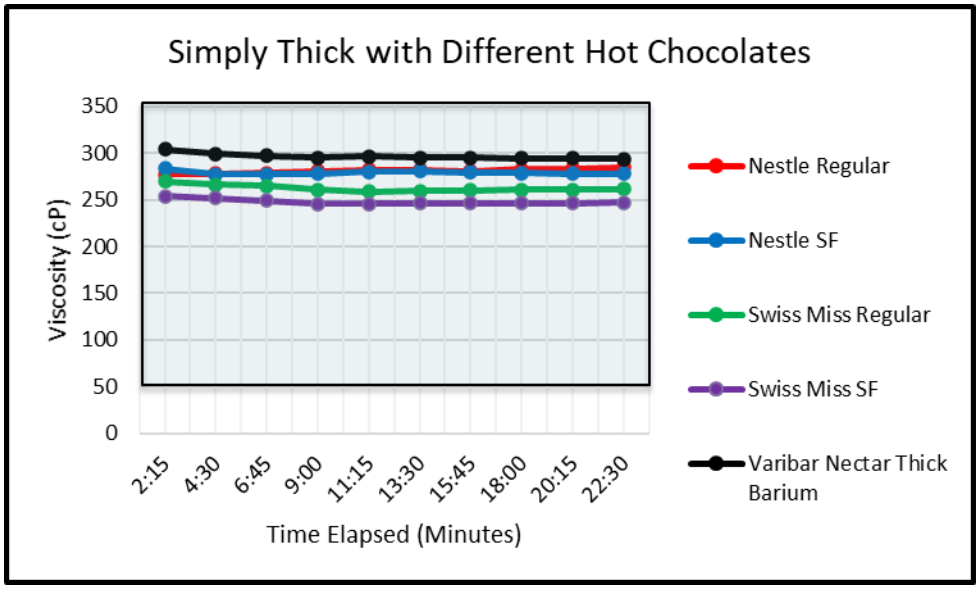

Figure 2. Simply Thick with Different Hot Chocolates

The hot chocolate recipes following the Simply Thick nectar consistency directions were all within the appropriate NDD range (51cP-350cP). The Nestle regular (276.8cP-284.8cP) had nearly the exact same viscosity range as the Nestle sugar free (276.8cP-283.2cP). The Swiss Miss regular (258.4cP-269.6cP) and Swiss Miss sugar free (245.6cP-253.6cP) did not overlap in viscosity, but they still maintained close viscosity ranges to each other as well as to the Nestle recipes. The Swiss Miss recipes were both slightly lower in viscosity compared to the Nestle recipes. All the recipes were fairly consistent with the Varibar Nectar Thick Barium (293.6cP-304cP), the biggest difference between a Simply Thick recipe and the barium was 58.4cP.

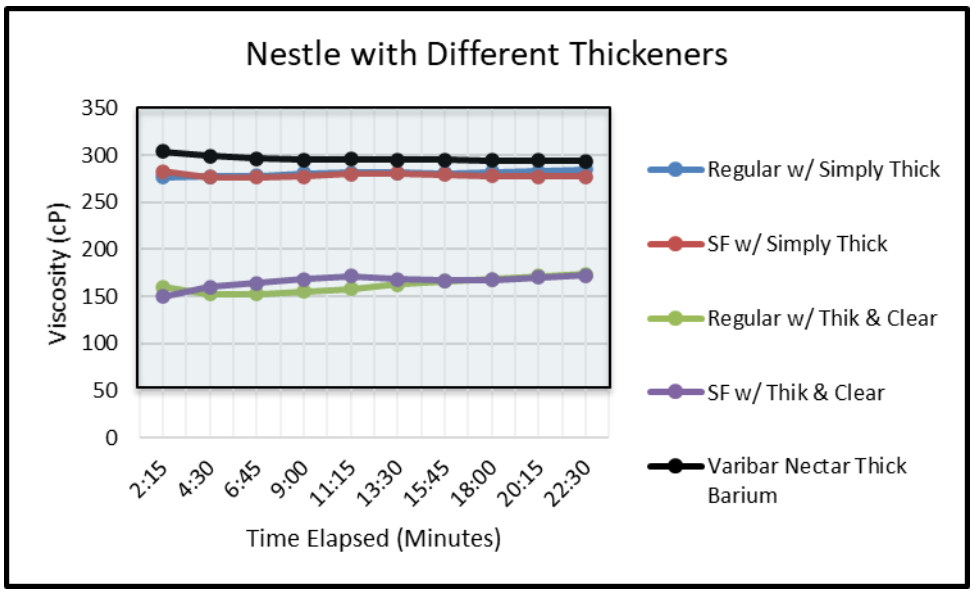

Figure 3. Nestle with Different Thickeners

Nestle brand hot chocolates reached a nectar consistency under both thickeners. When mixed with the same thickener, Nestle regular and Nestle sugar free recipes produced similar viscosities. However, the viscosity of Nestle mixed with Thik & Clear was much lower than the viscosity of Nestle mixed with Simply Thick. The biggest difference in viscosity between the thickeners was 135.2cP. The Simply Thick recipes were much closer to the Varibar Barium levels.

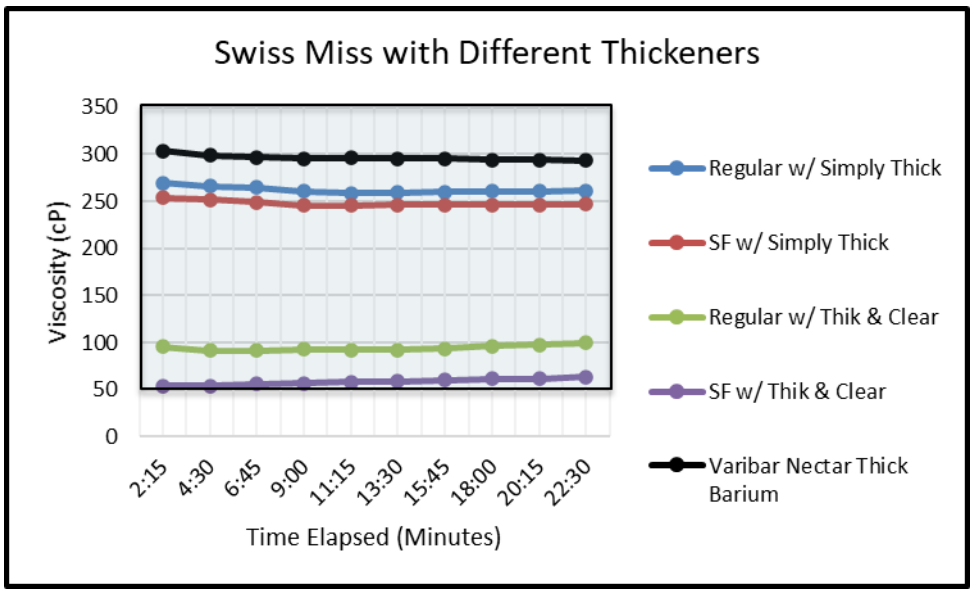

Figure 4. Swiss Miss with Different Thickeners

Swiss Miss brand hot chocolate reached a nectar consistency under both thickeners. The Swiss Miss regular and sugar free had similar viscosities when mixed with the same thickener, although the sugar free Swiss Miss had a slightly lower viscosity under both thickeners. There was a notable difference in the viscosity range between the two thickeners, with the Thik & Clear producing a lower viscosity. The recipes with Simply Thick were closer to the Varibar Barium.

Hot Chocolate Tested	Simply Thick Level 2		Thik & Clear Nectar	
	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level
Nestle Regular	3.3	1	3.6	1
Nestle SF	4.0	2	3.0	1
Swiss Miss Regular	2.8	1	2.0	1
Swiss Miss SF	2.9	1	0.6	0

Figure 5. IDDSI Test Results

The figure five chart displays the IDDSI results of all the recipes from figures one through four. Of these recipes, the only one that achieved the desired IDDSI level was the Nestle sugar free mixed with Simply Thick. This recipe only had 4.0mL remaining, putting it at the bare minimum for IDDSI level 2 (4.0mL-8.0mL). All of the other recipes fell short of the IDDSI goal by falling at IDDSI level 1. The exception to this was the Swiss Miss sugar free recipe mixed with Thik & Clear, which fell at an IDDSI level 0.

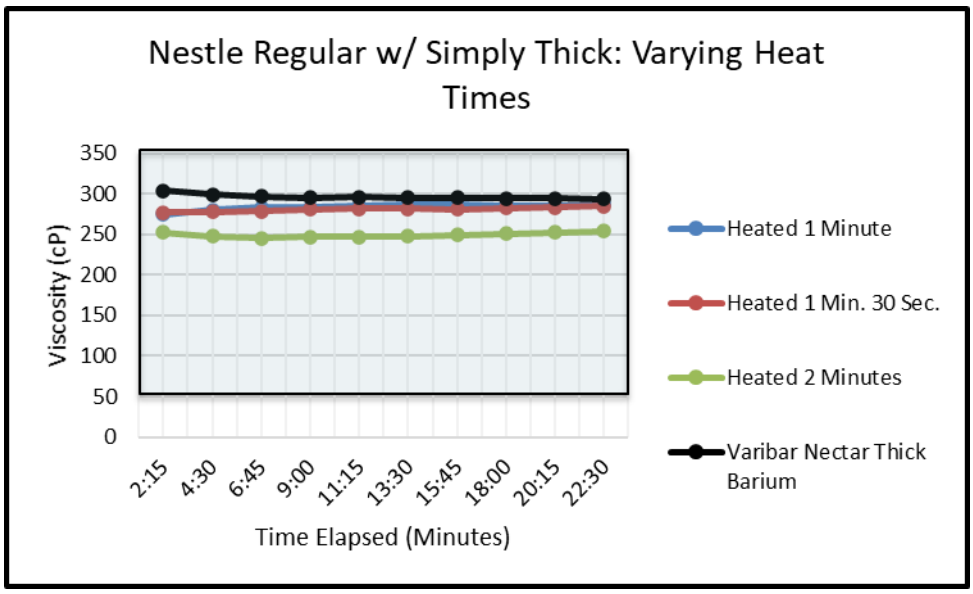

Figure 6. Varying Heat Times

The recipe conducted with varying heat times all were within the nectar consistency range. The recipe with water heated for one minute (274.4cP-287.2cP) overlapped in viscosity with the recipe were the water was heated for one minute thirty seconds (276.8cP-284.8cP) and close to the Varibar Barium viscosity (293.6cP-304cP). The recipe where the water was heated the longest at two minutes (245.6cP-253.6cP) was slightly lower in viscosity and consequently farther from the Varibar Barium.

Recipe Tested	Water Heated for 1 Minute		Water Heated for 1 Min. 30 Sec.		Water Heated for 2 Minutes	
	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level
Nestle Regular w/ Simply Thick Level 2	3.9	1	3.3	1	2.8	1

Figure 7. IDDSI Test Results with Varying Heat Times

The figure seven chart displays the IDDSI results of the recipes from figure six. This data shows that Nestle regular when mixed with Simply Thick remained in the same IDDSI level regardless of the three heat times and none of them met the desired IDDSI level 2 (4.0mL-8.0mL). The water heated for one minute did have the most mL remaining at 3.9mL and the water heated for two minutes had the least mL remaining at 2.8mL.

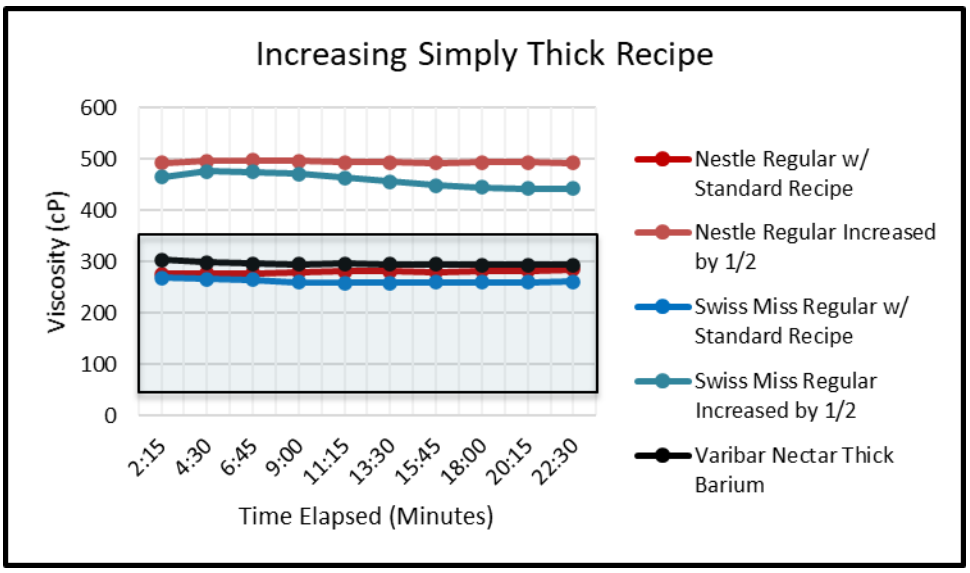

Figure 8. Increasing Simply Thick Recipe

Increasing the Simply Thick used in the recipe by ½ for Nestle regular (492.8cP-498.4cP) and for Swiss Miss regular (442.4cP-476.8cP) resulted in viscosities that exceeded the nectar consistency range. The standard recipes for these two hot chocolates had viscosities that were within the nectar consistency range and closer to the Varibar Barium. The Swiss Miss was slightly lower in viscosity compared to the Nestle with both recipes.

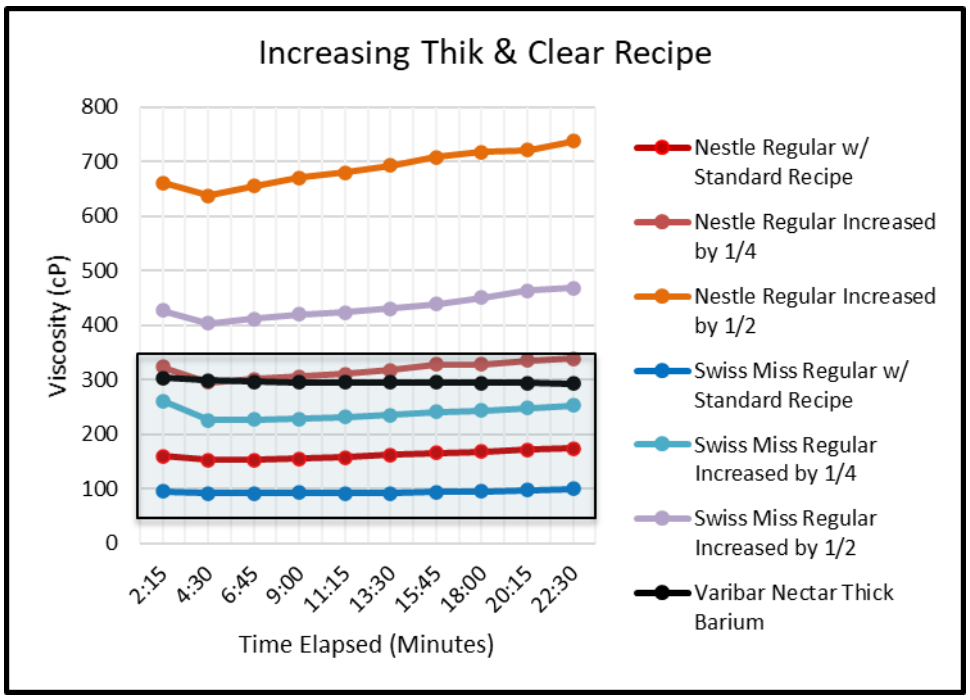

Figure 9. Increasing Thik & Clear Recipe

Increasing the Thik & Clear used in the recipe by ¼ for Nestle regular (295.2cP-339.2cP) and for Swiss Miss regular (226.4cP-260.8cP) produced viscosities within the nectar consistency range. This put both recipes increased by ¼ closer to the Varibar Barium than the standard recipes, with the ¼ increased Nestle recipe overlapping in viscosity with the Varibar Barium. Increasing the Thik & Clear used in the recipe by ½ for Nestle regular (637.6cP-738.4cP) and for Swiss Miss regular (403.2cP-468.8cP) resulted in viscosities that surpassed the nectar consistency range. The Nestle recipe increased by ½ had a significantly higher viscosity than the Swiss Miss recipe increased by ½. In all three thickener variations the Swiss Miss version of the recipe was lower in viscosity than the Nestle version.

Recipe Tested	Simply Thick Level 2		Thik & Clear Nectar	
	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level
Nestle Regular	3.3	1	3.6	1
Swiss Miss Regular	2.8	1	2.0	1
Nestle Regular (Thickener Increased by ¼)	N/A	N/A	5.5	2
Swiss Miss Regular (Thickener Increased by ¼)	N/A	N/A	5.3	2
Nestle Regular (Thickener Increased by ½)	6.8	2	8.4	3
Swiss Miss Regular (Thickener Increased by ½)	6.7	2	7.6	2

Figure 10. IDDSI Test Results of Recipes with Varying Amounts of Thickener

The figure ten chart displays the IDDSI results of the recipes from figures eight and nine. The data in the chart shows that increasing the thickener in the recipe by ¼ or ½ produced liquids meeting the desired target of IDDSI level 2, with the exception of Nestle regular in the recipe that increased the Thik & Clear thickener used by ½. The mL remaining for the recipes where Thik & Clear was increased by ¼ was similar between Nestle (5.5mL remaining) and Swiss Miss (5.3mL remaining). Likewise, the mL remaining for the recipes where Simply Thick was increased by ½ only had a 0.1mL difference between the Nestle (6.8mL remaining) and the Swiss Miss (6.7mL remaining). The recipe that increased the Thik & Clear by ½ had a slightly bigger difference in mL remaining between the Nestle (8.4mL remaining) and the Swiss Miss (7.6mL remaining).

Conclusion:

All of the recipes following the nectar consistency instructions fell within the appropriate NDDL range, but there was a lot of variation between thickeners and only one of those recipes following the package instructions reached the target of IDDSI level 2. Simply Thick produced significantly more consistent viscosities in the hot chocolates it was mixed with compared to Thik & Clear. Additionally, recipes with Simply Thick were closer to the Varibar Barium viscosity. Hot chocolates mixed with Thik & Clear exhibited mild to severe clumping that was not present in Simply Thick mixtures. However, the Nestle regular mixed with an additional ¼ of Thik & Clear was the only recipe that fell within the nectar consistency range, met the IDDSI level 2 goal, and overlapped with the Varibar Barium.

There were also differences between the two brands of hot chocolates. Overall, Nestle seems to mix better with thickeners than Swiss Miss. In every recipe, Swiss Miss had a lower viscosity than the Nestle version. There also seemed to be a slight difference between the Swiss Miss regular and the Swiss Miss sugar free. The Swiss Miss sugar free was consistently a lower viscosity than the Swiss Miss regular. Within the Nestle hot chocolates there were no notable variations between the regular and sugar free versions, and the viscosity of the Nestle regular and Nestle sugar free overlapped in every recipe.

In regards to variation in heat time, the differences did not seem to drastically impact the recipe. The recipe that was heated for 2 minutes did have less mL remaining in the IDDSI flow test and had a lower viscosity than the recipes that were heated for less, but it was still at the same IDDSI level as the other recipes and within the nectar consistency range.

Lastly, increasing the amount of thickener used in the recipe by ¼ or ½ got the liquids to the goal of IDDSI level 2 in all the recipes except for one. However, the recipes that increased the

thickener by ½ had viscosities that surpassed the nectar consistency range. The recipes that increased the thickener by ¼ were in the appropriate viscosity range, met the target IDDSI level, and were closer to the Varibar Barium, indicating that those might be the most effective recipes. However, this recipe was only tested with Thik & Clear and further investigation that includes other thickeners would need to be done.

Recommendations:

The results from this data would suggest that the Nestle brand hot chocolate, both regular and sugar free versions, thickens more desirably than the Swiss Miss brand hot chocolate. It also supports that Simply Thick is a more reliable thickener than Thik & Clear, but following the package instructions only achieved the target IDDSI level in one instance which indicates that a more reliable recipe is still warranted. The thickened hot chocolate recipe that increased the thickener by ¼ did meet all of the nectar consistency targets, but because of the inconsistencies and clumping associated with Thik & Clear the recipe cannot be confidently recommended. Further testing is required to determine a dependable recipe. Suggestions for areas of research include testing with other thickening agents, trialing other thickeners with the recipe that adds an additional ¼ of the thickener, and investigating a wider variety of heat times and the impact on the hot chocolates viscosity.

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Appendices

1. **Hot Chocolate Viscosity Data Sheets**